

WHERE IS AIR? ¹

Grade Levels: 4-6

Time: 30-35 minutes

Purpose

To demonstrate that although air is invisible to us, it is made of matter, occupies space, takes the shape of the container it's in, moves, and can move objects.

The lesson is important for building a foundation for other lessons regarding air and its properties, and to air pollution concepts. The lesson also helps students begin developing observation and prediction skills.

Background

Air is not empty space, but is made of matter that occupy space, and is present everywhere in the lowest part of the earth's atmosphere. It is very easy to overlook the fact that air is all around us because we cannot see it unless it contains enough visible solid or liquid particles to form clouds, fog, smog, or smoke. For example, we often forget that an "empty" bottle or room is actually full of air.

Air is composed of about 78% nitrogen gas (N₂), 21% oxygen gas (O₂), and 1% other gases such as argon (Ar), carbon dioxide (CO₂), methane (CH₄), and helium (He). Most of the gases such as N₂, O₂, and CO₂ are comprised of molecules that are made up of atoms, the fundamental unit of matter. Some gases such as Ar and He are just made up of atoms. Solid particles (e.g., dust, ash, etc.), water droplets, and ice crystals are also present in air, although they are not considered part of the normal composition of air.

However, collectively, air is composed of gases, solid particles, water vapor, ice crystals, and many other materials.

Objectives

Students will:

1. List three properties of air.
2. Explain the result of blowing up a balloon which is inside a bottle and seals the bottle's opening.
3. State five examples that demonstrate the presence and effects of air.

Materials

- 1-gallon plastic bottle per student (and 1 for the teacher)
- 1 balloon (12-inch "helium quality") per 1-gallon plastic bottle
- 1 pair of scissors per student
- Worksheet – Where is Air? (included)

¹ Adapted from Air and Waste Management Association, Environmental Resource Guide-Air Quality, Grades 3-5, "Here, There, and Everywhere" Activity, Pg. 29-46, 1996.

Activity

1. Show students a 1-gallon bottle and ask the question: Does anyone see anything in this bottle? (*No*).
2. Walk around to each student and squeeze the bottle quickly so that he/she can feel the puff of air on his/her arm.
3. Ask students the following questions: Is there something in the bottle? (*Yes*). How do you know? (*I felt it*). What did you feel? (*Air being pushed out*). How did it get into the bottle? (*Through the bottle opening*). Where did it come from? (*Outside of the bottle*). Can you see the air outside the bottle? (*No*).
4. Hand out the “Where is Air” Worksheet. Explain that although air cannot be seen, it is everywhere and we can see and feel its effects on us such as blown smoke or leaves, or a puff of air on our skin.
5. Give each student a 1-gallon bottle and balloon. Have him/her place the balloon inside the mouth of the bottle and stretch the mouth of the balloon over the outside edge of the mouth of the bottle (refer to Diagram 1 below).

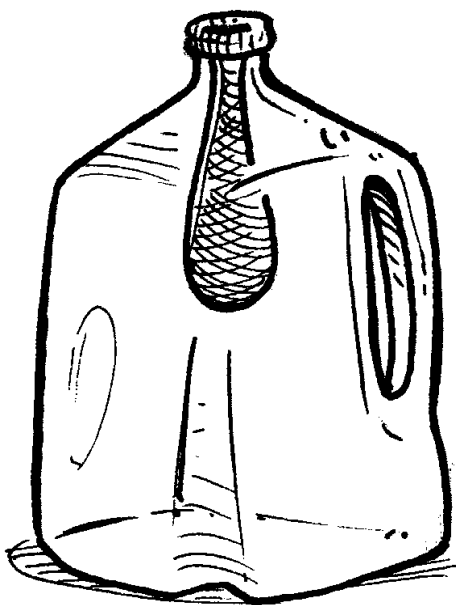


Diagram 1

6. Ask students what will happen to the balloon if they try to blow the balloon up while it is inside the bottle. (*The balloon will break the bottle, pop, or won't inflate*). Have students write their predictions in section #1 of the worksheet.
7. Have each student try to blow up his/her balloon several times.

8. Ask students why the balloon did nothing. (*The bottle contains air and air takes up space. Air occupies the space between the balloon and the inside of the bottle. When they try to blow up the balloon, the air between the balloon and the inside of the bottle prevents the balloon from inflating.*) Have students write their observations (i.e., what happened) in section #1 of the worksheet.
9. Ask students what can they change about the set-up that will allow them to blow up the balloon while it's in the bottle. (*Punch holes or cut a hole in the bottle to let the air out.*) Have students write their predictions in section #2 of the worksheet.
10. Using your 1-gallon bottle, show students how to cut an approximate 1-inch hole on the bottom center of their bottles.
11. Have students cut a hole in their bottles and then blow up their balloons several times (refer to Diagram 2 below).

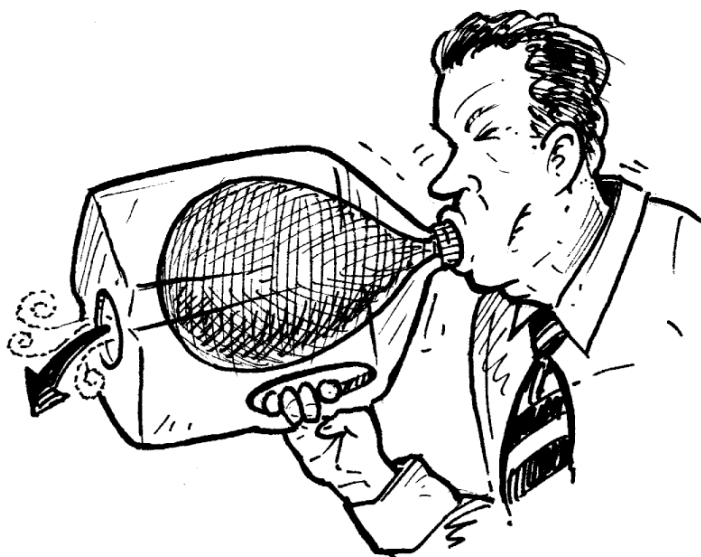


Diagram 2

12. Have students form pairs. Have one student place his/her hand or a sheet of paper next to the hole on the bottle while another student blows up the balloon. Have students switch roles and follow the same procedure.
13. Discuss why the balloon inflated and why they can feel or “see” the air being pushed out of the bottle when the balloon is inflated. (*The bottle contains air and air takes up space. The air is pushed out of the bottle by the inflation of the balloon. Since air occupies space, you can actually feel it while it is being pushed out of the bottle. It can also move objects.*) Have students write and draw their observations in section #2 of their worksheet.

14. Ask students why air occupies space. (*Air is made up of different materials, or matter, that occupy space.*) Ask individual students to write on the chalkboard the names of different materials that make up air and occupy space. (*Possible answers are gases such as nitrogen, oxygen, carbon dioxide, argon, methane, helium, and hydrogen; solid particles such as smoke, ash, dust, and soot; water vapor; and ice crystals.*)
15. Ask students what makes up the materials, or matter, that occupy space. (*The materials, or matter, are made up of very small units called atoms. Each atom occupies space and has weight. Some matter is made up of atoms. Most matter is made up of molecules, which are made up of atoms.*)
16. Have students give examples that demonstrate the presence and effects of air. (*Possible answers are wind blowing clouds, trees, grass, clothes, kites, etc.; blowing a ping pong ball on top of a table; blowing up balloons; or fans blowing streamers, paper, cooling people, etc.*)
17. Have students complete section #3 of the worksheet.

Student Understanding and Reflection

1. Discuss questions on the worksheet and solicit student responses.
2. Have students reflect on their learning:
 - (a) How have my ideas about air changed?
 - (b) Some examples of the presence and effects of air are...
 - (c) The most interesting discovery I made was...
 - (d) The air inside the bottle was pushed out the hole because...
 - (e) I am interested in learning more about...

Wrap Up

Explain that the balloon and bottle demonstration showed several properties of air such as occupying space, taking the shape of the container it's in, moving, and moving other objects.

Explain that although we cannot see air, it is present everywhere in the lowest part of the earth's atmosphere. It is made up of matter such as gases, solid particles, water droplets, and ice crystals. Most matter is composed of molecules (such as N₂, O₂, and CO₂) that are made up of atoms, the fundamental unit of matter. Some matter is just made up of atoms (such as Ar and He).

California Science Content Standards, K-12 (Adopted 1998)

Concepts of the lesson may be connected to the grade-specific content standards below:

Grade Four

- 6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

Grade Five

- 1b. Students know all matter is made of atoms, which may combine to form molecules.
6b. Develop a testable question.

Grade Six

- 7e. Recognize whether evidence is consistent with a proposed explanation.

Worksheet: Where is Air?

Name _____

Date _____

1. A balloon is placed inside the mouth of the bottle and the mouth of the balloon is stretched over the outside edge of the mouth of a bottle. Can you blow up the balloon?

Prediction:

Write what happened.

2. A balloon is placed inside the mouth of the bottle and the mouth of the balloon is stretched over the outside edge of the mouth of a bottle with a hole cut in its bottom. Can you blow up the balloon?

Prediction:

Write what happened. Draw a picture that shows what happened. (Hint: Where is the air going?).

3. Write 3 properties of air.